CLAIMS

What is claimed is:

1. An injection device for humidifying and dispersing reagents into a reactor space, comprising:

an exterior injection duct for injecting at least one gas at high-velocity into the reactor space;

at least one interior injector for injecting at least one reagent and at least one humidifying agent into the reactor space;

wherein the at least one interior injector is positioned coaxially inside the exterior injection duct for injecting, mixing, and dispersing the at least one reagent and the at least one humidifying agent in the reactor space,

thereby ensuring the mixing and dispersion of the at least one reagent and the at least one humidifying agent into the reactor by the high-velocity gas.

2. The injection device of claim 1, wherein the at least one interior injector includes at least one humidifying agent injector and at least one reagent injector for injecting respective at least one humidifying agent and at least one reagent, separately.

3. The injection device of claim 2, wherein the at least one humidifying agent injector further includes a coaxial dispersing gas duct.

4. The injection device of claim 3, wherein the injection device is a coaxial injector device comprising:

an exterior duct for high-velocity gas injection;

an outer-middle injector for liquid injection;

an inner-middle duct for low-velocity gas injection; and

an interior injector for liquid injection;

wherein the injectors and ducts are positioned coaxially; and

wherein, the exterior duct is formed by the internal wall of an insert and the external wall of the outer-middle injector; and is located externally to and circumferentially surrounds all other injectors and ducts; the outer-middle injector is formed by two concentric cylinders with end plate and injector nozzles; the inner-middle duct is formed by interior wall of the outer-middle injector and the exterior wall of the interior injector; the interior injector is formed by a cylinder with an endplate, the endplate having a nozzle.

5. The injection device of claim 1, wherein the at least one interior injector is slidable relative to the exterior injector to adjust the position an injection end of the at least one interior injector with respect to a reactor end of the exterior duct for providing controllable proximity of injection into the reactor space.

6. A multiple injection device system comprising: at least two injection devices according to claim 1, at least one reaction parameter probe, and at least one controller;

wherein the injection devices are located at spaced-apart locations along a reactor length;

the at least one reaction parameter probe is located downstream of the injector devices;

and the at least one controller communicates with the injection devices and the at least one reaction parameter probe to control the injection devices for providing controlled injecting, mixing, and dispersing the at least one reagent and the at least one humidifying agent in the reactor space.

7. The system according to claim 6, wherein the at least one reaction parameter probe measures at least one parameter selected from the group consisting of temperature, pH, relative humidity, chemical species, gas velocity, and combinations thereof.

8. The device of claim 6, wherein the at least one interior injector includes at least one humidifying agent injector and at least one reagent injector for injecting respective at least one humidifying agent and at least one reagent, separately.

9. The device of claim 6, wherein the at least one humidifying agent injector further includes a coaxial dispersing gas duct.

10. The device of claim 6, wherein the injection device is a coaxial injector device comprising:

an exterior duct for high-velocity gas injection;

an outer-middle injector for liquid injection;

an inner-middle duct for low-velocity gas injection; and

an interior injector for liquid injection;

wherein the injectors and ducts are positioned coaxially; and

wherein, the exterior duct is formed by the internal wall of an insert and the external wall of the outer-middle injector; and is located externally to and circumferentially surrounds all other injectors and ducts; the outer-middle injector is formed by two concentric cylinders with end plate and injector nozzles; the inner-middle duct is formed by interior wall of the outer-middle injector and the exterior wall of the interior injector; the interior injector is formed by a cylinder with an endplate, the endplate having a nozzle.

11. The system of claim 6, wherein at least one injection device injects at least one $NO_X$-reducing reagent and at least one injection device injects at least one $SO_X$-reducing agent.

12. The system of claim 10, wherein at least one injection device injects both at least one $NO_X$-reducing reagent and at least one $SO_X$-reducing reagent.

13. The system of claim 6, wherein the at least one interior injector is slidable relative to the exterior injector to adjust the position an injection end of the at least one interior injector with respect to a reactor end of the exterior duct for providing controllable proximity of injection into the reactor space.

14. A method for operating the system of claim 6, comprising the steps of:

sampling the reaction parameter;

selecting at least one injection device best suited for injecting a reagent for affecting a chemical reaction within the reactor to produce a desired result from the reaction;

injecting the secondary reagent through the at least one selected injection device.

15. A method for reducing the $NO_X$ in a combustion effluent, comprising the steps of:

providing a system according to claim 5;

sampling the effluent temperature;

selecting at least one injection device best suited for injecting an NH3-generating reagent for reducing $NO_X$ in the effluent;

injecting the NH3-generating reagent through the at least one selected injection device.

16. The method of claim 15, wherein the $NH_3$-generating reagent is urea.

17. The method of claim 15, wherein the $NH_3$-generating reagent is selected from the group consisting of: urea, ammonia, cyanuric acid, ammonium carbamate, ammonium carbonate, mixtures of ammonia and ammonium bicarbonate, one or more of the hydrolysis products of urea or mixtures or complexes thereof, compounds which produce ammonia as a byproduct, ammonium formate, ammonium oxalate, hexamethylenetetramine, ammonium salts of organic acids, 5- or 6- membered heterocyclic hydrocarbons having at least one cyclic nitrogen, hydroxy amino hydrocarbons, amino acids, proteins, monoethanolamine, guanidine, guanidine carbonate, biguanidine, guanylurea sulfate, melamine, dicyandiamide, calcium cyanamide, biuret, 1,1'-azobisformamide, methylol urea, methylol urea-urea condensation product, dimethylol urea, methyl urea, dimethyl urea and combinations thereof.

18. The method of claim 15, wherein injected fluids include high-velocity secondary air, cooling water, cooling air, and urea solution in the exterior duct, outer-middle injector, inner-middle duct, and interior injector, respectively, for the reduction of $NO_X$ in a combustion process.

19. An injection device for humidifying a reactor space comprising:

an exterior injection duct for injecting at least one gas at high-velocity into the reactor space;

at least one interior injector for injecting at least one humidifying agent into the reactor space;

wherein the at least one interior injector is positioned coaxially inside the exterior injection duct for injecting, mixing, and dispersing the at least one humidifying agent,

thereby ensuring mixing and dispersing of the least one humidifying agent into the reactor by the high-velocity gas.

20. The injection device of claim 19, wherein the at least one interior injector is slidable relative to the exterior injector to adjust the position an injection end of the at least one interior injector with respect to a reactor end of the exterior duct for providing controllable proximity of injection into the reactor space.